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AN EXPLORATORY STUDY OF DIGITALLY-ENHANCED ADVANCED SERVICES FOR DOMESTIC APPLIANCES IN THE UK

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1. INTRODUCTION

Traditionally, service research in the domestic appliances market have focused on after sales services and their operations, as a means to achieve competitive advantage and revenues of 20-30% of total sales for appliance manufacturers (Murali et al. 2016). Additional sources of revenue and longer engagement with customers along the whole product lifetime could be achieved by more integrated offerings of products and services. Servitisation strategies are progressively shifting manufacturers from basic to more advanced service offerings to complement their service portfolio (Benedetti and Neely 2018). Advanced services deliver a capability to the customer through the performance of the product, e.g. customer support agreement, risk and reward sharing contract, revenue through-use contract (Baines and Lightfoot 2014). Rental and pay-per-use schemes are other examples of advanced services. These services can potentially increase manufacturers' revenues, provide a stable source of revenue and unique differentiating factor from competitors (Oliva and Kallenberg 2003); however, their implementation and attainment vary in different industries due to specific industry conditions (Visnjic et al. 2019). There are limited instances of how advanced services may be applied in consumer markets such as the domestic appliances market.

The objective of this work is to investigate how innovative digital technologies can enable advanced services in domestic appliances and enhance decision making through data management and analysis across the service delivery networks. The research builds on the review of relevant literatures which identified gaps in how domestic appliances manufacturers can leverage the opportunities brought by servitisation and digital technologies.

We have conducted an exploratory qualitative study involving both academic and practitioners in order to obtain insights from a multi-disciplinary and multi-stakeholder perspective. Preliminary findings suggest a strong context dependency on customer appliance usage and behaviour as well as on service provider technical skills and resource availability. Identified potential technological enhancement for domestic appliances comes primarily from sensor, data analytics and connectivity technologies. Leveraging on these technologies will provide additional functionalities either as add-on services or within an advanced service offering.

2. BACKGROUND

Manufacturers' service offerings have been classified in multiple ways in literature, e.g. focused on a product or to end-user's process and being transaction or relationships-based (Oliva and Kallenberg 2003). Reviews of service offering classifications are available in Sacconi et al. (2014) and Gaiardelli et al. (2015). Broadly, they can be categorized into base (e.g. warranty and spare parts provision), intermediate (e.g. helpdesks, training, scheduled maintenance, repairs and overhauls) and advanced services (e.g. customer support agreements and outcome contracts) (Baines and Lightfoot 2014). Advanced services are the more sophisticated and complex services that focus on delivering a capability to the customer through product performance (Baines and Lightfoot 2014). They are also known as outcome-based contracts (Visnjic et al. 2017; Sjödin et al. 2020a), pay-per-use contracts (Martinez et al. 2017), result-oriented services (Tukker 2004) or performance-based contracts (Selviaridis and Wynstra 2015; Glas et al. 2019), among others. Advanced services are common in very diverse fields such as the industrial durable goods market, the defence industry and software industry (Visnjic et al. 2017; Ng et al. 2009).

The servitisation transformation process of a manufacturer towards successfully delivering advanced services constitutes four stages of progress defined as (Baines et al. 2020): exploration (i.e. investigating about the concept and finding out opportunities), engagement (i.e. evaluating and demonstrating the potential until organisation acceptance), expansion (i.e. increasing scale and speed of advanced services implementation) and exploitation (i.e. optimising the delivery of the advanced services portfolio). Measuring progress of this transformation journey requires a complex and multi-variable framework, integrating internal and external views as well as financial and non-financial measures (Ziaee Bigdeli et al. 2018). Supportive individual-level tactics can help overcome issues along the path towards servitisation from the internal perspective, i.e. in relation to adapting organizational culture, strategy, structures, and processes (Lenka et al. 2018). Other success factors include internal alignment of the servitisation strategic orientation of the company with both its internal organisation and its service portfolio offerings, and external alignment with the customer and the service network (Alghisi and Sacconi 2015). Moreover, Baines et al. (2020) identify five forces determining progress along the servitisation transformation process which are internal to the organisation, such as organisational readiness and organisational commitment, and external to the organisation, such as the extent of customer pull, the strength of technology push, and the structure of the value network positioning.

The service network perspective becomes key in this type of services. The delivery of advanced services to the customer involves not only the manufacturer but also other actors, e.g. suppliers, partners, intermediaries, within the value network in order to bring the performance outcome to the customer. According to Martinez et al. (2017), companies adapt their service offerings and processes to the evolving customers' needs and requirements in close collaboration with key suppliers and partners. The study done by Story et al. (2017) identified unique and critical capabilities for different actors as follows:

- For manufacturers: balancing product and service innovation, developing customer-focused through-life service methods, and having distinct and synergistic product and service cultures;
- For intermediaries: coordination and integration of third party products/services;
- For customers: co-creating innovation and having processes supporting service outsourcing.

The concept of service co-creation jointly with customers is frequently discussed in the servitisation literature, in both consumer and industrial goods markets (Oertzen et al. 2018). It involves implicitly and actively the customer in the process of value creation (Vargo et al. 2008). The relationship with the customer is one of the key aspects of servitisation (Rabetino et al. 2017). In the case of advanced services, the service providers have the opportunity of establishing long-term relationships with customers (Visnjic et al. 2017), and of learning more about customers' needs and operation conditions (Grubic 2014). This feedback can be used to improve the service offering to better match actual, and evolving, customers' needs (Allmendinger and Lombreglia 2005; Grubic 2014).

One of the key forces in a servitisation transformation process is the availability of and access to technologies, particularly to digital technologies, i.e. technology push' (Baines et al. 2020). The links between digital technologies and servitisation have been acknowledged in recent literature, and the concept of 'digital servitisation' has been coined (Vendrell-Herrero et al. 2017). It is defined as *"the transformation in processes, capabilities, and offerings within industrial firms and their associate ecosystems to progressively create, deliver, and capture increased service value arising from a broad range of enabling digital technologies"* (Sjödin et al. 2020b).

Advanced services support customers after they have got delivery of a product. In order to enable these services, technology enablers that could be used include Internet-of-Things (IoT), Augmented Reality (AR), Virtual Reality (VR), and blockchain as well as additive manufacturing during product manufacturing (Johnson 2017) to mention a few. The IoT type technologies enable the collection of data from a source to transmitting it to a location where algorithms could either be brought to bear to extract insights from the data or visualized in order to provide remote customer support service, pay per usage contract models as well as open the opportunity to charge services via the pay by the load models (Paritala et al. 2017).

In consumer products, there have been interest in the use of IoT and Artificial Intelligence (AI) in appliances such as dishwashers, smartphone operated roller shutters and smart vacuum cleaners (Kaczorowska-Spychalska 2018). The area that these technologies have gained the most penetration is in the control of smart appliances such as speakers, thermostats, tvs and lights (Mocrii et al. 2018). However, these are currently not used for advanced service provision yet. The sensors and actuators for these devices are currently added as an afterthought to carve out unique niche market spaces. However, in the future, through lithography solutions, these will be inherently fabricated as part of the product itself (Zhu et al. 2018) and hence open up unique opportunities for advanced services currently not realized.

3. RESEARCH METHOD

This work was conducted through literature review and qualitative research methods, which included a focus group with multidisciplinary scholars, and a set of semi-structured interviews with personnel from organisations that are involved (or to be potentially involved) in the delivery of advanced services for domestic appliances.

The multidisciplinary focus group took the form of a workshop, with participating scholars from different disciplines. The workshop helped to advance the scoping of advanced services in domestic appliances, to validate literature review findings, and to identify any missing themes. Next, the workshop outcomes were used to design the questionnaire for the semi-structured interviews. Interview participants included practitioners involved in the design, manufacturing and service of domestic appliances, as well as other stakeholders of the service network e.g. technology providers, consumer associations. Details on the methods employed are provided in next subsections.

This approach brings together academia and industry views to form a comprehensive outlook on current status and potential challenges and barriers to a wider implementation of advanced services to domestic appliances.

3.1 Multi-disciplinary workshop

Workshop participation was by-invitation only and invitees were selected to cover a wide range of disciplines within the social sciences, engineering, computer science and information systems. Eight scholars eventually participated in the workshop in November 2019. The workshop objectives were defined as follows:

- to discuss the range of advanced services that could be applied to domestic appliances;
- to create a map of digital innovations, including themes such as the potential data collection and analysis enhancement;
- to identify relevant aspects that need to be taken into account for the development of advanced services for domestic appliances.

The workshop was organised to provide an initial introduction and overview on the research, followed by group discussions based on a set of three templates to cover three key topics: (1) Designing service offerings for domestic appliances; (2) Understanding the customer journey for advanced service offerings; (3) Analysing digital technologies in advanced service offerings. While the templates for exploring topics 1 and 3 were developed ad-hoc, topic 2 was explored through the use of a service blueprint (Bitner et al. 2008). The workshop finalised with a joint discussion on the emerging themes.

3.2 Interview-based study

We conducted an exploratory qualitative study based on a set of nine semi-structured interviews with practitioners working for a wide range of organisations related to the domestic appliances sector. These organisations are involved in areas along the life cycle of domestic appliances, e.g. design, manufacturing, service. We followed a purposeful sampling approach (Creswell 2006, p.125) and selected participants that could provide insights and contextual information from different angles.

Participants selection criteria were the following: (1) include a wide range of domestic appliance manufacturers; (2) include both manufacturers which own brands and which do not own brands; (3)

include potential suppliers or partners, e.g. technology providers; (4) include professional bodies and / consumer associations, as interested stakeholders. Selection was done by searching list of companies within the sector in Orbis database and direct internet search. Participants were contacted via email, whenever it was available, or via LinkedIn. Response rate was around 40%. The final sample included 4 participants from manufacturing companies, an independent consultant, a participant from a research institution, 2 participants from a technology provider, and a participant from a consumer association. The latter was included to obtain insights on the consumer perspective.

Most interviews were conducted via Skype (only one was face-to-face) in February and March 2020, and had durations between 30 min and 1h 20 min. Interviews were transcribed and then analysed following a theme-based coding.

4. PRELIMINARY RESULTS AND DISCUSSION

4.1 Summary of workshop key findings

Context dependency emerged as one of the key themes while discussing potential advanced services for domestic appliances. It was not particularly clear what contextual features were essential to designing and implementing the advanced services; some potential aspects could be related to e.g. usage intensity, appliance lifetime and replacement rate, technical skills and customer relationships. Thus, the term 'context' needed to be unpacked further to identify the key elements that can make the advanced service offering successful or not.

Further analysis needed also to include a better understanding of different types of customers, their needs and their actual demand for this type of services. This could include aspects of customer loyalty and retention, communicating with the customer about the service offering, and understanding the customer needs in terms of appliance functionality.

Technological enhancement for domestic appliances seems to originate primarily from the use of sensor, analytics and connectivity technologies, according to workshop discussions. Leveraging on these technologies to provide additional functionalities to the customer either as add-on services or within an advanced service offering needs to be considered when designing the service portfolio, according to contextual features and customers' needs and requirements. Implications on product design, technical safety, legal and contractual issues, and customer perceptions of the advanced service offering were also identified as further areas of inquiry within this research.

4.2. Preliminary findings from practitioners interviews

This section presents an overview of our key findings related to mapping the status of service offerings for domestic appliances, and to the use of enabling technologies in future advanced service offerings.

Table 1 presents a summary of findings related to the current and prospective service offerings based on each of the exploratory interviews conducted. It also includes insights on the drivers or enablers for the transition to advanced services. It is worth that the outlook obtained was quite consistent across all categories of current services, including the absence of advanced services within the current offerings. The envisaged offerings for intermediate services and advanced services had higher variation, which highlights the broad range of ways in which more outcome-oriented business models could be defined for domestic appliances.

All interviewees acknowledged the perception of the domestic appliances industry moving towards advanced services. Drivers and enablers vary from market-led e.g. increased competition and threat from technology platforms, to technology-led e.g. increased availability of technologies at lower costs, and benefits-led e.g. envisaged lower environmental impact and higher revenue streams along the appliance lifetime.

Table 1: Overview of service offerings and drivers /enablers of change, based on interview insights.

Interviewee (Organisation type)	Base		Intermediate		Advanced	Drivers / enablers of the change towards advanced services
	Current	Future	Current	Future	Future	
Senior technical fellow (R&D Organisation)	Network monitoring through sensors.	Extending range of processes.	Monitoring of the processes themselves. Fault diagnosis.	Using environment data to make process more effective / efficient.	Using environment data to optimise process.	Sustainability, environmental impact, lower cost sensor systems, connectivity of devices, and lower cost availability of analysis.
Independent consultant	Spares provision, warranty.	Retrieving location, operation and service history in situ or remotely.	Scheduled annual maintenance by central heating professionals.	House buyers accessing service history (condition monitoring).	Track and trace of boiler's entire lifecycle.	Lack of visibility, control and reward in the value transactions downstream in supply chain.
Customer insight manager (Manufacturer 1)	Spares provision, warranty.		Maintenance plans for own and other household products.	From customer managing devices via own app to company smart maintenance plan.	IoT sensors (new products and retrofit) for remote diagnostics and support leading to pay per outcome.	Product becoming commoditised and risk of loss to supply chain value to technology platforms by not having relationship with customer enabled by IoT advances.
Product development manager (Tech provider)	Spares provision, warranty.		Heating management via smart sensors.	HVAC diagnostics, an emerging technology.	Energy response programme. Provider changes house thermostat to reduce grid peaks.	Threats from technology platforms.
Managing director (Manufacturer 2)	Spares provision, warranty.				Not alone, use distributors with a supply contract basis or a per outcome item basis.	Volume absent for domestic offer.
Managing director (Manufacturer 3)	Third party spares, warranty.	Warranty included in spare parts supply.	We offer everybody spare parts.	Maintaining the condition of the appliance.	Selling capability in a pay-per-output or rental basis.	Threat of dealer providing customer with low cost entry without need to for expensive upfront cost.
Senior technologist (Manufacturer 4)	Spares provision, warranty.	Services based on analytics of customer behaviour.	Technical helpdesk and in-house engineers fleet for repairs.	Services based on analytics of customer behaviour	Pay per use schemes potential for high demand communal kitchen and laundry areas	House space at premium for low use items, food ordering seen as cheaper. Digital technologies used for payment and checking availability.
Marketing manager (Technology provider 2)	Spares provision, warranty.		Service to support design and test		Installers not providers have relationship with customer due to volume	Need to build value proposition and identify revenue stream to offset cost of long term availability warrantees.

The technologies most often mentioned were related to IoT, i.e. sensor technology and connectivity, which confirms their enabling potential for advanced service design and provision. Sensors, especially smart sensors and devices such as smart thermostats and smart meters were seen as essential for understanding the usage patterns once the appliance is installed in households and for service providers to activate and perform potential service-related actions in a remote manner. Remote monitoring technology seems to be one of the key enablers, as highlighted in literature (Suppatvech et al. 2019; Grubic 2014). One of the interviewees indicated the potential use of data regarding the environment in which the appliance operates to optimise processes, e.g. washing at a temperature that minimises energy consumption while getting the job done.

Connectivity enabled by e.g. Wi-Fi technology is understood to be key for advanced services provision. Standard communication protocols will be required as a consequence of multi-device environments. Additionally, concerns were raised regarding appliances being only functional upon internet connectivity which will require stable access to connectivity.

Software applications and platforms were mentioned as helpful to provide ubiquitous information and control to customers, for example with mobile apps.

Another example is the potential use of data recorded directly on appliances for facilitating service interactions. Moreover, the potential use of blockchain to help managing small and frequent payments, e.g. in pay-per-use schemes, was also suggested.

Our findings indicate data requirements for advanced service providers regarding: (1) appliance performance and any deviations from targets indicated in labels or service agreements; (2) customer use of appliance and any deviations from recommended operating conditions or intended use; (3) customer preferences, wants and needs. Specific envisaged uses of these data items within an advanced service offering were identified as:

- Feeding back to the customers information about how the appliances are really performing in use, or the external factors which are influencing it;
- Providing advice to customers for achieving better performance and use of the appliance;
- Ensuring maintenance can be scheduled when it is actually needed rather than just an interval which is deemed to be appropriate;
- Identify issues that the appliance/s system may be having, as well as making sure that the system is set up to run optimally;
- Taking remote actions to ensure optimal performance, e.g. switching on/off appliance when energy costs are lower for the customer;
- Improving appliance design e.g. in terms of efficiency and sound, according to actual customer needs and wants.

Challenges and barriers mentioned during the interviews were manifold, and some of the emerging themes were the following: (1) development of a sound advanced service business model, (2) impact on current business model and sales, (3) balancing the cost of embedding the technology and setting up the platform / system, (4) access to the broad range of skills and resources needed to set up the system (5) resistance from external actors such as installers and technicians, (6) balancing the service oriented mind-set with the current product orientation, (7) balancing the potential to provide a wide range of functionality with simplicity and easiness to use for customers, (8) communicating the value for money of these advanced services to customers, (9) need for competitors to work together, (10) dealing with technical issues potentially affecting appliance durability and longevity.

Some of the above mentioned challenges and barriers are common to the transformation towards delivering advanced services and have been observed overall in the servitisation literature (Alghisi and Saccani, 2015), while there are new ones related to the specific case of domestic appliances, and how the industry structure is currently organised, as well as to the specific challenges related to the cost and potential complexity implied when integrating novel technologies. Thus, these are interesting

areas to focus further research in order to support companies to overcome these envisaged challenges and barriers for the implementation of advanced services in domestic appliances.

5.CONCLUDING REMARKS

This work builds on perspectives from service innovation, operations management and digital manufacturing. Servitization research foundations on strategy, capabilities, and processes for transitioning to the provision of advanced services (Baines et al. 2020; Ziaee Bigdeli et al. 2018), and on conditions and tactics to overcome organizational resistance to servitization (Lenka et al. 2018) have been considered. The methodological approach followed in this exploratory qualitative study includes a multidisciplinary focus group with scholars from four institutions, and a set of semi-structured interviews with industrial stakeholders involved (or to be potentially involved) in the delivery of advanced services for domestic appliances.

Identified most promising technologies for advanced services in domestic appliances are sensor, data analytics and connectivity technologies. They can help collecting and processing customer and appliance performance related information. Besides this, software applications and platforms, and blockchain technology were mentioned for information sharing and control, and facilitating payment processing, respectively. Findings have uncovered the potential for value creation of implementing technology-enhanced advanced services in this particular consumer market, although a set of challenges and barriers have also been identified and will be the subject of further research.

This work contributes to the servitisation research field by improving understanding of how digital technologies can support the delivery of advanced services for domestic appliances. It uncovers interdisciplinary research areas to advance knowledge on the drivers, benefits, barriers and mechanisms to introduce these advanced services. The research findings could inform both the UK industrial and research strategy agendas by providing evidence to future policies related to smart appliances development. Managerial implications of this work include support for manufacturers of domestic appliances to identify pathways to develop and enhance their current service offerings towards higher value advanced services.

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